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| 09/180,629 | 11/12/1999 | Aaron Fenster | 1814.31 | 7008 |

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| EXAMINER | |
|---|---|
| SUKHAPHADHANA, CHRISTOPHER T | |
| ART UNIT | PAPER NUMBER |
| 2625 | 14 |

DATE MAILED: 05/07/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 09/180,629 | FENSTER ET AL. | |
| | Examiner | Art Unit | |
| | Christopher T. Sukhaphadhana | 2625 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *07 March 2003* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1-13* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-13* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☒ The proposed drawing correction filed on *07 March 2003* is: a)☒ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *12* .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

## DETAILED ACTION

### *Response to Amendment*

1. An Amendment, Change of Address, IDS, and Drawings were received 07 Mar 2003.

2. The Amendment has been entered in full.

3. Based on Applicant's amendments and drawing changes, the objections to the drawings, specification, and claims are withdrawn.

4. Based on Applicant's amendments, the 35 U.S.C. 112, second paragraph, rejections are withdrawn.

### *Drawings*

5. The proposed drawing correction and/or the proposed substitute sheets of drawings, filed on 07 Mar 2003 have been approved. A proper drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The correction to the drawings will not be held in abeyance.

### *Response to Arguments*

6. Based on Applicant's arguments, the 35 U.S.C. 112, first paragraph, rejections are withdrawn.

7. Applicant's arguments filed 07 Mar 2003 have been fully considered but they are not persuasive.

8. The Applicant's arguments against the 35 U.S.C. 102(b) rejections to claims 1, 3, and 13 can be summarized to two points: 1) Fast linear reconstruction has never been previously shown

with respect to fan and axially acquired ultrasound data to rapidly and accurately provide a three dimensional image of a target tissue, and 2) The amendments to claim 1 (and similarly to claim 13) render the claim(s) novel and inventive over the cited prior art of record. Each of these points is addressed below.

a. **Fast linear reconstruction has never been previously shown with respect to fan and axially acquired ultrasound data to rapidly and accurately provide a three dimensional image of a target tissue.** In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., 'fast linear reconstruction' and 'fan and axially acquired ultrasound data') are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims.

b. **The amendments to claim 1 (and similarly to claim 13) render the claim(s) novel and inventive over the cited prior art of record.** In regards to claim 1, Quistgaard (U.S. Patent 5,485,842, already of record) further discloses a transformation means responsive to user selection of a three-dimensional image surface to be displayed (col 8, lines 21-44), the transformation means receiving the digitized two-dimensional images and the data set (ref no 32, Fig 1), representing the three-dimensional image (col 8, lines 32-34) and transforming only image data within the received two-dimensional images that is necessary to view the selected three-dimensional image surface (col 8, lines 28-32). A similar argument applies towards claim 13. No specific arguments were directed towards claim 3.

9. The Applicant's arguments against the 35 U.S.C. 103(a) rejections to claims 2 and 5 can be summarized as: Fenster does not teach or suggest fast-linear reconstruction of fan and axially acquired data as recited in claim 1. Please refer back to the argument regarding claim 1 above.

10. The Applicant's arguments against the 35 U.S.C. 103(a) rejections to claims 4, 9, and 10 can be summarized as: The cited references applied towards these claims, Fenster (U.S. Patent 5,842,473) and Hossack (U.S. Patent 6,360,027), disclose the aspects being claimed, but they do not suggest such aspects in conjunction with a three-dimensional imaging system where only specific image data from fan and axially acquired two dimensional image slices actually required to view the user-selected image undergoes reconstruction. Fenster and Hossack are indeed in the same field of endeavor (three-dimensional ultrasound imaging) as Quistgaard (see respective abstracts) and are thus analogous art and considered pertinent to the claimed invention. The remainder of the argument addresses limitations not set forth within the claims and can be addressed in a similar fashion as the argument of claim 1.

11. The Applicant's arguments against the 35 U.S.C. 103(a) rejections of claims 6, 7, and 8 are similar to an argument presented for claim 1. A similar response as applied to claim 1 applies to the corresponding arguments of claims 6, 7, and 8.

12. The Applicant's arguments against the 35 U.S.C. 103(a) rejections of claims 11 and 12 can be summarized as: Yamazaki is silent to a transformation means described in the claim. Examiner stated in the prior office action how Yamazaki reads on claims 11 and 12 and maintains the rejection.

***Claim Rejections - 35 USC § 102***

13. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

14. Claims 1, 3, and 13 are rejected under 35 U.S.C. 102(b) as being anticipated by Quistgaard (U.S. Patent 5,485,842).

15. In regards to claim 1, Quistgaard discloses a three-dimensional imaging system comprising a scanning means (ref no 10, Fig 1) to scan the target volume using an angular scanning technique (col 4, line 5), and generate a succession of two-dimensional images representing cross-sections of the target volume on a plurality of planes spaced around an axis of rotation of the scanning means (col 4, line 15); a memory means (ref no 34, Fig 1) storing the succession of digitized two-dimensional images (1', 2', 3' in Fig. 5a-d) and a data set comprising parameters defining the geometric (col 4, lines 59-63) and orientational (col 7, lines 60-63) relationship between successive digitized images; and a transformational means for receiving the digitized two-dimensional images and the data set (ref no 32), and a transformation means responsive to user selection of a three-dimensional image surface to be displayed (col 8, lines 21-44), the transformation means receiving the digitized two-dimensional images and the data set (ref no 32, Fig 1), representing the three-dimensional image (col 8, lines 32-34) and transforming only image data within the received two-dimensional images that is necessary to view the selected three-dimensional image surface (col 8, lines 28-32).

16. In regards to claim 3, Quistgaard further discloses the angular scanning technique as a fan scanning technique (col 4, line 5).

17. In regards to claim 13, all the elements set forth in this claim have been addressed in the argument of claim 1.

### *Claim Rejections - 35 USC § 103*

18. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

19. Claims 2 and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Quistgaard as applied to claim 1 above, in combination with Fenster et al (U.S. Patent 5,454,371).

20. In regards to claim 2, Quistgaard does not specifically disclose the angular scanning technique as an axial scanning technique.

Fenster '371 teaches the use of an axial scanning technique (Fig. 4) for use in a three-dimensional imaging system similar to Quistgaard.

The ultrasonic probe (10) of Quistgaard would undergo the motion of Fenster's probe (24) indicated by arrow 48 to achieve the desired scanning technique.

It would have been obvious to one of ordinary skill in the art at the time of the invention to combine Fenster's axial scanning technique with Quistgaard's probe because the utilization of

this scanning technique would be effective for scanning organs of a subject under examination, such as the eye or prostate (Fenster '371, col 5, lines 35-38).

21. In regards to claim 5, Quistgaard does not specifically disclose storing data defining the degree of out-of-plane tilt of the transducer, the degree of out-of-plane displacement, nor the degree of in-plane tilt.

Fenster '371 teaches of using said data (col 8, lines 24-52) to compensate for inaccuracies in the final reconstructed three-dimensional image (col 8, lines 63-65). Once said data were known, it would have been obvious to one of ordinary skill in the art at the time of the invention to store said data because they are constant for any set of image lines of an image array to be reconstructed (col 10, lines 23-38) and can be reused for such reconstruction without unnecessary recalculation.

22. Claim 4, 9, and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Quistgaard as applied to claim 1 above, and further in view of Fenster et al (U.S. Patent 5,842,473) and Hossack et al (U.S. Patent 6,360,027).

23. In regards to claim 4, Quistgaard additionally discloses the storage of the total angle of acquisition (col 6, lines 35-54). Quistgaard anticipates the storage of a 90deg sector image (col 6, line 40). This storage of this value is necessary to estimate the amount of physical space the image represents as shown in Figure 3, and this value can be used to keep track of virtual viewpoint changes as shown in col 5, lines 20-43.

Quistgaard further discloses the storage of the total number of acquired images (col 4, lines 19-23). Quistgaard anticipates the typical storage of 100 to 200 images (col 6, line 20). A

data structure used to store images commonly employed and known to one skilled in the art is an image data array, as evidenced in Hossack et al, ref 18. A property inherent to an array data structure is the index of each element of the array, typically used for selective access to a desired element, as well as the bounds of the numeric value of the index usually described by one skilled in the art as the "length" of the array. The length of the array is stored in memory and used to ensure that access to the images do not extend beyond the number of images stored in memory, and this length value represents the total number of two-dimensional images taken. One skilled in the art would use an image data array as the method of data storage because it provides quick access to any given image.

Quistgaard does not disclose the remaining limitations set forth in claim 4.

Fenster '473 teaches the storage of an address pointer of the location of the images (col 2, line 24), the horizontal and vertical voxel sizes (col 2, lines 27-32), and the width and height of each acquired image (col 2, line 26).

Hossack et al teaches the storage of the location of the axis of rotation with respect to each of the images (col 8, lines 3-6), the relative location of each acquired image to the transducer (col 5, lines 6-11), and the angular separation of each image (col 13, lines 3-8 and col 16, lines 20-23).

It would have been obvious to one of ordinary skill in the art at the time of the invention that the information taught by Fenster '473 and Hossack as described can be stored in a header file to each image, because such a practice was well known in the art. Fenster '473 teaches that this information can be used to allow a display module to interpret the acquired image data correctly (col 6, lines 19-23), and Hossack et al teaches that this information can be used in

registering the respective image data frames appropriately in three-dimensions to form the desired three-dimensional representation (col 2, line 66).

24. In regards to claim 9, Fenster '473 further discloses the width and height of each acquired image as the number of pixels along the x and y axis of each two-dimensional image (col 2, line 26).

It would have been obvious to one of ordinary skill in the art at the time of the invention to store the total number of two-dimensional images taken as the total number of acquired images because the total number of two-dimensional images taken is the maximal number of two-dimensional images the system would need access from the image data array. Quistgaard's system stores planar (two-dimensional) images (col 4, lines 20-21).

25. In regards to claim 10, Fenster '473 further discloses the horizontal and vertical voxel sizes as the physical distance between adjacent pixels (col 2, lines 28-30).

26. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Quistgaard as applied to claim 1 above, and further in view of Fenster et al (U.S. Patent 5,842,473), and Hossack et al (U.S. Patent 6,360,027).

27. In regards to claim 6, Quistgaard does not teach the storage of the parameters as comprised in claims 6 and 7.

Fenster '473 teaches calibrating for the horizontal and vertical voxel sizes in col 6, lines 44-52.

Hossack et al teaches storing the location of the axis of rotation with respect to each of the images (col 8, lines 3-6).

It would have been obvious to one of ordinary skill in the art at the time of the invention to store this calibration information because it is used to interpret the image data correctly (Fenster '473, col 6, line 19-23).

28. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Quistgaard, Fenster '473, and Hossack et al as applied to claim 6 above, and further in view of Fenster et al (U.S. Patent 5,454,371).

29. In regards to claim 7, Quistgaard, Fenster '473, and Hossack do not specifically disclose storing calibration data comprising the degree of out-of-plane tilt of the transducer, the degree of out-of-plane displacement, nor the degree of in-plane tilt.

Fenster '371 teaches of using said calibration data (col 8, lines 24-52) to compensate for inaccuracies in the final reconstructed three-dimensional image (col 8, lines 63-65). Once said data were known, it would have been obvious to one of ordinary skill in the art at the time of the invention to store said data as calibration data because they are constant for any set of image lines of an image array to be reconstructed (col 10, lines 23-38) and can be reused for such reconstruction without unnecessary recalculation.

30. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Quistgaard as applied to claim 1 above, and further in view of Fenster et al (U.S. Patent 5,842,473), and Hossack et al (U.S. Patent 6,360,027).

31. In regards to claim 8, Quistgaard additionally discloses the storage of the total angle of acquisition (col 6, lines 35-54). Quistgaard anticipates the storage of a 90deg sector image (col 6,

line 40). This storage of this value is necessary to estimate the amount of physical space the image represents as shown in Figure 3, and this value can be used to keep track of virtual viewpoint changes as shown in col 5, lines 20-43.

Quistgaard further discloses the storage of the total number of acquired images (col 4, lines 19-23). Quistgaard anticipates the typical storage of 100 to 200 images (col 6, line 20). A data structure used to store images commonly employed and known to one skilled in the art is an image data array, as evidenced in Hossack et al, ref 18. A property inherent to an array data structure is the index of each element of the array, typically used for selective access to a desired element, as well as the bounds of the numeric value of the index usually described by one skilled in the art as the "length" of the array. The length of the array is stored in memory and used to ensure that access to the images do not extend beyond the number of images stored in memory, and this length value represents the total number of acquired images. One skilled in the art would use an image data array as the method of data storage because it provides quick access to any given image.

Fenster '473 teaches the storage of the width and height of each acquired image (col 2, lines 23-32).

Hossack et al teaches the storage of the relative location of each acquired image to the transducer (col 5, lines 6-11) and the angular separation of each image (col 13, lines 3-8 and col 16, lines 20-23).

It would have been obvious to one of ordinary skill in the art at the time of the invention that the information taught by Fenster '473 and Hossack as described can be stored in a header file or an associated information file to each image upon the acquisition of said image, because

such a practice was well known in the art. Fenster '473 teaches that this information can be used to allow a display module to interpret the acquired image data correctly (col 6, lines 19-23), and Hossack et al teaches that this information can be used in registering the respective image data frames appropriately in three-dimensions to form the desired three-dimensional representation (col 2, line 66).

32. Claims 11 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Quistgaard as applied to claim 1 above, and further in view of Yamazaki et al (U.S. Patent 5,497,776).

33. In regards to claim 11, Quistgaard does not expressly disclose a means to generate a reverse map.

The specification defines a reverse map as a look-up table or partial look-up table used to determine the location within the succession of two-dimensional image slices of the particular pixels which must be retrieved from memory to produce the display image selected by the user (p 11, line 30).

Yamazaki et al teaches the display of side planes (col 11, line 18) where the side planes displayed are determined by the position of cross section lines set by the user (col 11, line 1). The reference reads on the claim because in each case, a method of selecting pixels from the stored images relies on an input (look-up table or cross section lines) to determine which pixels should be selected for display. In other words, the cross section lines determine which pixels to be displayed from the stored images in the same manner the look-up table determines which

pixels to display for the present invention. Thus, the reference performs the same function as the claim.

It would have been obvious to one of ordinary skill in the art at the time of the invention to combine the transformation means of Yamazaki et al with the system of Quistgaard because Quistgaard's system displays only the three-dimensional image while Yamazaki's transformation means can display the three-dimensional image and a base plane on one screen (Fig 5a).

34. In regards to claim 12, Quistgaard does not expressly disclose the reverse map enclosing edges of the images nor an orientation in a plane orthogonal to the planes of the images.

Yamazaki further teaches his transformation means incorporates the edges of the acquired images (Fig 4) and displaying an orientation orthogonal to the planes of the images (Fig 4 and col 11, line 19).

*Conclusion*

35. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event,

however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

36. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Christopher T. Sukhaphadhana whose telephone number is 703-306-4148. The examiner can normally be reached on 9a-4p M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bhavesh Mehta can be reached on (703) 308-5246. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9314 for regular communications and 703-872-9314 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-306-0377.

CTS

CTS
May 5, 2003

BHAVESH M. MEHTA
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